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REVIEW

Indications and decision making in single and multiple treatment of the anterior sector

Indicaciones y toma de decisiones en el tratamiento unitario y múltiples del sector anterior

Ianina Solange Silvera[1]

[1]Universidad Abierta Interamericana. Buenos Aires, Argentina.

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ABSTRACT

Gingival recessions, characterized by apical displacement of the gingival margin and exposure of the root surface, pose both esthetic and functional challenges. This paper reviews the indications and decision making in the management of anterior gingival recessions, a crucial aspect in esthetic and restorative dentistry. Over the years, the evolution of mucogingival surgery towards periodontal plastic surgery has led to the development of various surgical techniques, such as connective tissue grafts and advanced coronal flaps. These techniques aim to provide effective and durable root coverage, adapting to the specific anatomical characteristics of each patient. The selection of the most appropriate surgical technique depends on a detailed evaluation of local anatomical factors and the patient's esthetic expectations. While it is possible to maintain periodontal health with a minimal amount of keratinized gingiva, gingival recessions remain common, especially in individuals with thin periodontal phenotypes. An interdisciplinary approach is essential to ensure outcomes that optimize both periodontal health and esthetics in the long term.

Keywords: Gingiva; Periodontics; Tissue Regeneration; Congenital Anomalies; Esthetics.

RESUMEN

Las recesiones gingivales, caracterizadas por el desplazamiento apical del margen gingival y la exposición de la superficie radicular, plantean desafíos tanto estéticos como funcionales. El presente trabajo revisa las indicaciones y la toma de decisiones en el manejo de recesiones gingivales en el sector anterior, un aspecto crucial en odontología estética y rehabilitadora. A lo largo de los años, la evolución de la cirugía mucogingival hacia la cirugía plástica periodontal ha permitido desarrollar diversas técnicas quirúrgicas, como los injertos de tejido conectivo y los colgajos avanzados coronales. Estas técnicas buscan proporcionar una cobertura radicular efectiva y duradera, adaptándose a las características anatómicas específicas de cada paciente. La selección de la técnica quirúrgica más adecuada depende de una evaluación detallada de factores anatómicos locales y de las expectativas estéticas del paciente. Si bien es posible mantener la salud periodontal con una cantidad mínima de encía queratinizada, las recesiones gingivales siguen siendo frecuentes, especialmente en individuos con fenotipos periodontales delgados. El enfoque interdisciplinario es fundamental para garantizar resultados que optimicen tanto la salud periodontal como la estética a largo plazo.

Palabras clave: Encía; Periodoncia; Regeneración Tisular; Anomalías Congénitas; Estética.

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INTRODUCTION

Mucogingival disorders are acquired alterations in the morphology, position, or quantity of the gingiva surrounding the teeth, which include gingival recession, defined as the apical displacement of the gingival margin beyond the cementoenamel junction with exposure of the root surface, which may affect one or more teeth.[1]

Currently, these alterations are an integral part of cosmetic and restorative dentistry. Patients often express concern about the appearance of their teeth and the soft tissues, with recession being one of the most common concerns. Although aesthetic compromise is usually the main reason for consultation, tooth sensitivity, caries, and cervical lesions are also common reasons.[2]

Trends and social media have led to high demands when establishing aesthetic parameters, forcing professionals to develop new techniques and procedures to achieve predictable and long-lasting results effectively. Over the last 30 years, surgical techniques have been proposed to treat single and multiple gingival recessions, using displaced flaps, free grafts, bilaminar techniques, or even regenerative procedures using guided tissue regeneration techniques or enamel matrix derivatives.[3]

Despite this, the intention to modify or treat soft tissue conditions dates back a long time. The term mucogingival surgery was coined in 1957 by Nathan Friedman and was later complemented by periodontal plastic surgery in 1993 by Dr. Miller. It was established as a specialty in periodontics in 1990. The beginnings of mucogingival surgery were the use of free grafts and the treatment of aberrant frenula or alterations extending beyond the mucogingival line.[4]

There are multiple classifications for identifying recessions, each describing a specific area. For example, the Miller classification seeks to predict the success of root coverage, similar to the Cairo classification. In contrast, the Pini and Prato classification evaluates the need to reconstruct lesions at the cementoenamel junction.[5,6,7]

On the other hand, the American Academy of Periodontology and the European Federation of Periodontology, in their current classification of periodontal and peri-implant diseases and disorders, mention mucogingival deformities, establishing parameters that modify the gingival tissue: These include periodontal phenotype, the presence of gingival recessions, lack of keratinized gingiva, gingival excess, and alterations of exposed root surfaces, among others. This way, it guides decision-making for better performance and therapeutic action.[8]

On the other hand, coverage percentages vary according to the anatomical conditions of the area or teeth to be treated, as well as the type of recession the patient has, the presence of muscle insertions, shallow vestibular depth, root prominence, narrow papillae, etc. Therefore, selecting one technique over another depends on the anatomical characteristics of the site to be treated and the patient's demands.[9]

For all the above reasons, this study aims to consider the clinical parameters and the articles and techniques described to provide a more accurate approach to decision-making in treating single and multiple gingival recessions.

METHOD

The following work refers to a theoretical discussion, conducting research through a bibliographic search of scientific articles from the last ten years in various digital databases such as Scielo, Medline, Lilacs, Pubmed, Google Scholar, digital libraries in English and Spanish, using the following descriptors: "mucogingival alterations"; "gingival recessions"; "multiple recessions"; "free graft"; "connective tissue graft"; "coronal displaced flaps"; "gingival recession coverage."

Books on the subject will be used to describe the gingiva periodontal complex in the teeth.

Inclusion criteria

- Scientific articles on patients diagnosed with single or multiple gingival recessions.
- Any research study (clinical practice, clinical trial, observational study) will be valid.

Exclusion criteria:

- Articles that do not report clinical data.
- Articles that refer to orthodontic and orthognathic treatments about recessions, laser treatments, iatrogenic considerations, endoperiodontal relationships, and treatments with hyaluronic acid.
- Of 521 articles, 190 were selected that met the inclusion criteria for the bibliographic review.

RESULTS AND DISCUSSION

Historical background

Periodontics as a science was founded in 1946, giving rise to the first Latin American Periodontology Society. Years later, in 1986, the glossary of terms established its definition as a branch of dentistry that diagnoses and treats diseases and conditions of the tissues that support and surround the tooth, as well as their replacement implants. Later, in 1993, it was defined as a specialty within dentistry comprising the prevention, diagnosis, and treatment of diseases of the tissues surrounding and supporting the teeth and their substitutes and the maintenance of the health, function, and aesthetics of these structures and tissues.[9,10] This is how it has evolved, establishing its importance for daily practice.

Periodontics, now called "the conscience of dentistry," is present in various specialties because it has unquestionable relationships with other areas of the profession. However, as a differentiated specialization, it may seem young compared to other specialties.

The current classification of periodontal and peri-implant diseases and disorders from 2017 summarizes the health, disease, and gingival disorders observed on teeth and/or their substitutes. Gingivitis is defined as gingival inflammation and the absence of detectable clinical attachment loss due to previous periodontitis. A case of periodontitis is established when clinical attachment

loss is detected in at least two or more non-adjacent teeth or clinical attachment loss is detected on free surfaces greater than or equal to 3 mm with a probing depth greater than 3 mm, provided that the clinical attachment loss is not due to conditions other than periodontitis.[9]

Since its inception with Dr. Fermín Carranza in 1934, the treatment of periodontal disorders has required complementary surgery, mostly using resective techniques.[10] In 1964, interest began to grow in preserving the condition of the soft tissues surrounding the tooth using mucogingival techniques developed by Dr. Nathan Friedman.[11] A few years later, in 1993, Dr. Preston Miller introduced periodontal plastic surgery, which seeks to prevent or correct anatomical problems, developmental defects, or defects caused by trauma or disease of the gums, mucosa, or alveolar bone.[5]

DEVELOPMENT

He gingival margin is clinically represented by a scalloped line that follows the contour of the cementoenamel junction.[12] Gingival recession is an apical displacement of the gingival margin with exposure of the root surface to the oral cavity.[4,6,9]

The American Academy of Periodontology glossary defines gingival recession as "the apical migration of the gingival margin beyond the cementoenamel junction".[6]

Mucogingival disorders are acquired alterations in the morphology, position, or amount of gingiva surrounding the teeth, including gingival recessions that may affect one or more teeth.[1,13] They are commonly located on the vestibular surfaces, although they can also be found in the palatal and lingual areas, although less frequently.[9]

Modifications affecting the gingival tissue range from the periodontal phenotype, gingival recession, lack of keratinized gingiva, gingival excess, and alterations of exposed root surfaces. Thus, the new classification guides decision-making for better performance and therapeutic action.[8]

The term periodontal phenotype refers to the combination of gingival and bone morphotypes. The former indicates the three-dimensional gingival volume, while the latter establishes the thickness of the bone plate. The definition of phenotype accounts for the appearance of an organ based on the multifactorial combination of genetic traits and environmental factors, including the genetic biotype of the organ in question. Thus, phenotype indicates a dimension that can vary over time depending on environmental factors and clinical intervention, being specific and independent for each site.[8]

The distinction between different phenotypes is based on the anatomical characteristics of the periodontal components, including gingival thickness (GT), keratinized tissue width (KTW), and bone morphotype (BM). It has been reported that the thin phenotype is associated with GT ≤1 mm, KTW between 2,75 and 5,44 mm, with an average of 4,15 mm, and BM 0,343 mm, while the thick phenotype is associated with GT >1 mm. KTW between 5,09 and 6,65 mm, with an average of 5,72 mm and BM of 0,75 mm.[14,15]

Among mucogingival deformities, lack of keratinized tissue and gingival recession are the most common. A recent consensus concluded that a minimum amount of keratinized tissue is unnecessary to prevent attachment loss when conditions are good. However, the attached gingiva is essential for maintaining gingival health.[15]

Etiology

The diagnosis is often determined during a clinical examination at the dental office. However, in other cases, patients reconsider the appearance of their teeth and soft tissues and bring their concerns to the attention of professionals due to an alteration. Although aesthetic concerns are usually the main reason for consultation, tooth sensitivity, caries, and cervical lesions are also common reasons.[2,4,9,16]

An extensive literature search revealed the following findings: 1) periodontal health can be maintained in most patients with routine dental care; 2) thin periodontal phenotypes are at greater risk of developing gingival recession; 3) oral hygiene, orthodontic treatment, and inadequate cervical restorations can increase the risk of developing gingival recession; 4) surgical intervention, either to change the phenotype and/or to cover roots, may be indicated when the risk of developing or progressing pathology and associated root damage is increased and to meet the aesthetic requirements of patients.[15]

Although the etiology of gingival recession remains unclear, several predisposing and triggering factors have been suggested, including brushing trauma, tooth malposition, the presence of restorations and cervical lesions, inadequate oral hygiene, orthodontic movements, braces traction, persistent gingival inflammation, periodontal phenotype.[4,9,14,17]

The impact of improper toothbrushing was evaluated during a systematic review, which found inconclusive results. Some studies concluded that toothbrushes reduced recession on facial surfaces; others concluded that there appeared to be no relationship between brushing frequency and gingival recession. In contrast, others reported a positive association between frequency and recession. All reported risk factors during brushing, such as brushing duration, brushing force, toothbrush replacement frequency, bristle hardness, and brushing technique.[9,18] Continuing along these lines, trauma from improper use of dental floss can contribute to gingival lesions characterized by being deep and narrow, similar to "Stillman's fissure." The initial lesion may appear as a linear V-shaped ulcerated cleft with edematous edges and a red surface, reversible as long as flossing is discontinued. However, if the cleft appears white, the gingival lesion is irreversible.[9]

The position of the teeth in the alveolar process affects the amount of gingiva inserted around the tooth, with variation in gingival width, keratinized tissue width, and bone morphotype. The buccal or vestibular position of the teeth is often associated with thin phenotypes.[9,15]

On the other hand, gingival recession may begin or progress during or after orthodontic treatment, depending on the direction of movement. Some researchers claim that gingival recession is associated with lip movement; however, when a vestibulolingual tooth moves lingually, the dimension of the tissues in its vestibular portion will increase in width.[9,15,19]

A thin periodontal phenotype, absence of keratinized tissue, and reduced alveolar bone thickness due to tooth position in the arch are considered anatomical risk factors for developing and progressing gingival recession, including fenestrations or bone dehiscences. In correlation with tissue characteristics, individuals with thin phenotypes have narrow, long teeth. They are more prone to recession compared to those with a thick phenotype, where individuals have short, wide teeth.[9,15,20]

Sites with minimal or no gingiva associated with restorations close to the cervical areas are more prone to gingival recession and inflammation. The authors concluded that gingival augmentation is indicated in these clinical situations.[15]

The current consensus considers the presence of approximately 2 mm of gingival width and approximately 1 mm of gingival thickness, together with optimal bacterial plaque control, essential for maintaining gingival health.[15]

Non-carious cervical lesions (NCCL) are modifications of the root surfaces with potential loss of the cementoenamel junction and formation of steps of varying depth and extent depending on their etiology. Several studies reveal the high prevalence of NCCL with recessions.[15]

Epidemiology

Mucogingival defects, including gingival recession, occur frequently in adults and tend to increase with age, occurring in populations with high and low oral hygiene standards.[13,15] Their incidence varies from 8 % in children to 100 % after age 50.[17]

A 2003 study found that 88 percent of people aged 65 and older and 50 percent aged 18 to 64 had one or more sites with gingival recession. They also found that the prevalence of 1 mm or more recession in people aged 30 and older was 58 percent and increased with age. Men and African Americans had significantly more gingival recession than women and other racial/ethnic groups, respectively.[18]

Recession was also more frequent and severe on vestibular surfaces than in the interproximal areas of the teeth. Similarly, the frequency of gingival recession increased with age and was higher in men than in women of the same age.[13,21]

The results of a systematic review and meta-analysis conducted between 1991 and 2021 from five electronic databases and manual searches aimed to estimate the global prevalence of gingival recession in the general population. A total of 15 studies with 37 460 participants were included, finding that more than two-thirds of the world's population was affected by gingival recession.[22]

Classification

There are multiple classifications of gingival recession, each describing a specific area of great importance as they determine how to organize knowledge and justify decision-making when choosing a procedure.[9,16,23]

Many classifications have diverse reasons; some remain unchanged over time, while others seek to incorporate new knowledge.

In chronological order, they are Sullivan and Atkins (1968), Miller (1983), Pini Prato (2010), and Cairo (2011).[5,6,7,24] In this paper, we will use the Miller and Cairo classification analysis, the most widely referenced in the literature.

Sullivan and Atkins (1968) classified gingival defects into four morphological categories: superficial-narrow, superficial-wide, deep-narrow, and deep-wide.[18]

Miller (1985) proposed four types of gingival recession based on the height of the gingival margin relative to the mucogingival junction and the level of the underlying alveolar bone.[5,25]

- In class I, gingival recession does not reach the mucogingival junction, and there is no loss of interproximal bone.
- In class II, gingival recession extends to or beyond the mucogingival junction, and there is no interproximal bone loss.
- In class III, gingival recession reaches the mucogingival junction, and interproximal bone is lost.
- In class IV, gingival recession extends to or beyond the mucogingival junction, with severe interproximal bone loss.

In addition, Miller proposed a prognosis or feasibility of root coverage for each classification. For classes I and II, total coverage is established; for class III, partial coverage and absence of root coverage for class IV.[5,9,25]

In 2010, Pini and Prato proposed a clinical classification of superficial defects in teeth associated with gingival recession. Four classes of dental surface defects in areas of gingival recession were identified based on the presence (Class A) or absence (Class B) of the cementoenamel junction and the presence (Class +) or absence (Class -) of surface discrepancy.[6,9] This classification is used to assess the need to reconstruct lesions at the cementoenamel junction before surgery.[24]

Cairo describes a system for classifying gingival recession defects into three types, considering the level of interproximal clinical attachment. In addition, he establishes a prediction of the final results of root coverage according to the type of gingival recession.[7,9]

- In type 1 recession (TR1), there is no loss of interproximal attachment, and clinically, the amelocemental junction at the interproximal level is not detectable mesially or distally to the tooth.
- Type 2 recession (TR2) is associated with interproximal attachment loss. The amount of interproximal attachment loss (measured from the interproximal amelocemental junction to the interproximal pocket depth) is less than or equal to the buccal attachment loss (measured from the vestibular amelocemental junction to the vestibular pocket depth).
- Type 3 gingival recession (TR3) is associated with loss of interproximal attachment, but this is greater than the loss of buccal attachment.

Clinical diagnosis

The clinical factors to consider when deciding on treatment are the depth and type of recession, the presence of muscle attachments, the shallow depth of the vestibule, root prominence, tooth position, interdental clinical attachment level, gingival tissue phenotype, history of root coverage surgery, and site aesthetics. These factors determine the success of root coverage surgery;

therefore, selecting one technique over another depends on the anatomical characteristics of the site to be treated and the patient's demands.[9,26]

The predictability of root coverage estimates the percentage of exposed root surfaces that can be covered with soft tissue. For the correct evaluation of this parameter, it is necessary to recognize the cementoenamel junction of the affected tooth or teeth. When the cementoenamel junction is not recognizable, it is no longer possible to measure the depth or width of the recession and thus evaluate the effectiveness of a surgical technique in terms of root coverage due to the lack of a reference parameter.

The root percentage refers to the amount of root surface covered by gingiva. It is expressed as a percentage and is used to assess the periodontal health of a tooth, with the gingiva ideally covering at least 85 % of the root surface for good periodontal health. On the other hand, root coverage refers to the surgical procedure performed to increase the gingiva covering the exposed root surface. Therefore, the clinical healing pattern can only be determined in gingival recessions where the cementoenamel junction is clinically detectable and can be assessed in percentage and/or complete root coverage.[9,13,16,23]

The ideal papilla height in a tooth with gingival recession was defined as the apicocoronal dimension of the interdental papilla capable of supporting complete root coverage. The ideal papilla height was measured as the distance between the point where the cementoenamel junction crosses the angle of the facial mesial-distal line of the tooth called the angular point of the cementoenamel junction, and the contact point. The angular point of the cementoenamel junction is easily identifiable, even in a tooth with non-carious cervical lesions. Once the ideal papilla was measured, this dimension was replaced apically, starting from the tip of the mesial and distal papillae of the tooth with the recession defect. The horizontal projections at the recession margin of these measurements allowed the identification of two points connected by a scalloped line, representing the 'root coverage line.' Therefore, the most important prognostic factor for root coverage after surgery is the height of the interdental periodontal support.[22,23,26]

Surgical techniques

Over the last 30 years, different surgical techniques have been proposed to treat single and multiple gingival recessions, using displaced flaps, free grafts, bilaminar techniques, or even regenerative procedures using guided tissue regeneration techniques or enamel matrix derivatives.[7,9,13,16,27]

The term mucogingival surgery, introduced by Friedman in 1957, applies to surgical procedures used to resolve problems related to the interrelationship between the gingiva and the alveolar mucosa, designed to preserve gingival tissue, such as pockets extending apically to the mucogingival junction, frenulum malposition, and inadequate vestibular depth.[11] For this reason, in 1993, Miller introduced the term periodontal plastic surgery, which was defined as surgical procedures performed to prevent or correct anatomical, developmental, traumatic, or disease-induced defects of the gingiva, alveolar mucosa, or bone. This definition was accepted by the international scientific community in 1996 and includes various soft and hard tissue procedures aimed at gingival augmentation, root coverage, correction of mucosal defects in implants, crown lengthening, gingival preservation in ectopic tooth eruption, removal of aberrant frenula, prevention of crest collapse associated with tooth extraction, and edentulous ridge augmentation.[9,16]

A single gingival recession occurs when only one tooth in the arch is affected. The probable cause is factors such as overly vigorous tooth brushing, tooth malposition, or local trauma such as perioral perforations.[9,16] Characteristics present in single gingival recessions include:

- Loss of gingival tissue on a single tooth or area of the gum.
- Exposure of the tooth root.
- Tooth sensitivity.
- Aesthetic alteration of the smile.
- Increased risk of periodontal disease.

Multiple recessions are observed when gingival recession affects several teeth in different mouth areas. Associated causes include orthodontic movements, occlusion problems, or periodontal disease.[9,16] Clinical characteristics of multiple gingival recessions include:

- Loss of gingival tissue on several teeth or areas of the gum.
- Exposure of multiple tooth roots.
- Generalized tooth sensitivity.
- Aesthetic alteration in multiple areas of the smile.
- Increased risk of periodontal disease in various areas of the mouth.

Epithelized Palatal Graft (EPG) / Free Gingival Graft (FGG)

The use of free gingival grafts in periodontal therapy was first described by Bjorn in 1963 to create a wider area of attached gingiva. However, interest in palatal mucosa grafting began with Nabers' work on this technique to deepen the vestibular sulcus.28–30 Sullivan and Atkins described the method in 1968, and it was later modified by Miller in 1982.[27]

The surgical steps to perform the technique are as follows:[29]

- A partial-thickness flap is prepared in the recipient area, extending 5 mm more apically beyond the bone dehiscence and mesiodistally reaching one more tooth on each side of the area to be treated. The incision is horizontal, with the scalpel blade oriented perpendicular to the base of the papillae, seeking a good fit between the graft and the base of the papillae, as well as proper vascularization of the donor tissue. At both ends of the horizontal incision, two vertical incisions parallel to each other are made, extending apically to the mucogingival line, and the gingiva is partially dissected until a recipient bed is obtained.

- Prepare the root surface with curettes, conditioning the surfaces by removing calculus and root cementum. Make a surgical template with the dimensions of the graft to be taken.
- On the palate, with the template's support, the graft's dimensions are traced in the premolar area with a safety margin of 2-3 mm from the gingival margin. The epithelialized graft is removed with a thickness of 1,5 mm and placed in a saline solution to prevent dehydration.
- The graft is adapted to the recipient site and secured with simple sutures in the papillae and suspensory ligaments or in a cross pattern to compress and stabilize the donor tissue on the bed. The operated area is protected with surgical cement. Antibiotic therapy is indicated, and the sutures are kept in place for 10 to 14 days, after which the cement and sutures are removed.

Free gingival grafting for root coverage is a single-stage procedure with high predictability, regardless of the quality or quantity of gingival tissue adjacent to the recession. Its main indication is to increase the amount of attached gingiva to allow for proper hygiene, although it should be used with caution in cosmetically sensitive areas due to the inconsistent color matching of the graft with the gingival tissues, as well as the expected 40 % shrinkage.[28,31]

Connective Tissue Graft (CTG) / Bilaminar Technique

Since the mid-1990s, physicians have introduced several modifications to the original bilaminar procedure described by Raetzke. He created a flap in the palate to obtain a connective tissue graft placed coronally between a partial thickness and underlying periosteum.[29] Its design offers several advantages over epithelialized or free grafts, including increased blood supply to the graft through intimate contact with surrounding tissues, a reduced tendency for graft shrinkage, and more aesthetic color integration in the treated area.[27,30,32,33]

The surgical method used consists of the following steps:

- A collar of tissue is removed from the receded gingiva, the width of which corresponds to the depth of the sulcus, to remove the sulcular epithelium.
- The affected tooth's root is carefully scraped and brushed until its surface is smooth and hard. Citric acid is then applied to it.
- Through a partially thickened incision, a "wrapping" or "envelope" is created in the tissue around the surface of the exposed root.
- In the premolar/molar region of the palate, near the teeth, two incisions are made with a 1 to 2 mm separation in the anterior/posterior direction. Their length should be twice the width of the recession area. They are carried to the depth of the palatal mucosa, where they converge just before the bone.
- A portion of tissue is removed, and a small strip of epithelium is excised. The epithelium may be left in the middle of the graft, which remains over the exposed root.
- The graft is placed in the previously created lobe envelope to completely cover the previously exposed area of the root. Pressure is applied with the fingers using a piece of gauze until the bleeding stops and the graft is firmly in place. It is then secured with adhesive tissue, and sutures are required. The area is covered with a eugenol-free periodontal dressing for one week.
- the wound's edges are adapted using sutures in the donor area. Due to the small extent of the superficial defect, no additional protection is necessary.

In 1985, Langer and Langer described the use of subepithelial connective tissue grafting as a procedure that allows for an increase in the amount of keratinized gingiva, as well as root coverage. They designed a technique consisting of a rectangular incision with two horizontal and two vertical incisions.[27,34,35]

In 1992, Harris proposed two surgical techniques: the free gingival graft method with a blade, in which a partial-thickness flap is created by pushing the scalpel blade distally under control through the palate, and the parallel incision method using a single incision with a double-bladed scalpel to take a 1,5 mm thick graft with an epithelial margin.[36]

In 1994, Bruno harvested the donor tissue with a first incision in the palate perpendicular to the longitudinal axis of the teeth, approximately 2 to 3 mm apical to the gingival margin of the maxillary teeth. The mesiodistal length of the incision is determined by the graft length required for the recipient site. The second incision is made parallel to the longitudinal axis of the teeth, 1 to 2 mm apical to the first incision, depending on the graft thickness required. The incision is made apically to provide sufficient connective tissue height to cover the recipient site's denuded root and adjacent periosteum. A small periosteal elevator elevates a full-thickness periosteal connective tissue graft.[37]

In 1999, Hürzheler used an incision parallel to the gingival margin to access the donor site. The graft can be harvested in the desired size and thickness without removing any strips of epithelium with the connective tissue, and the palatal donor site can be healed by primary intention. The length of this incision corresponds to the intended purpose of the graft with a 90-degree angle of the scalpel blade to the bone. After the first incision, the scalpel blade is angled at approximately 135 degrees, and an undercut is made towards the first incision. With each new movement of the scalpel along the incision line, the angle becomes flatter until the blade reaches a position almost parallel to the bone surface. The partial thickness preparation can be observed from the outside of the tissue by trying to lift the tissue as the instrument is advanced. No vertical incisions should be made. This procedure aims to create a partial-thickness mucosal flap with a thickness of 1 to 1,5 mm, depending on the needs of the recipient site.[38]

In 2010, author Giovanni Zucchelli conducted a randomized controlled clinical trial in which root coverage treatment was performed on 50 patients. In the control group, connective tissue grafts were harvested using the trap door technique, while in the test group, free gingival grafts were harvested and subsequently de-epithelialized. Both types of grafts were effective in root coverage for treating gingival recession. A more significant increase in gingival width was achieved in the test patients; this may be due to the improved postoperative stability of the connective tissue resulting from the de-epithelialization of the free gingival grafts.[34,39]

Carranza, in 2020, proposes a modified double scalpel technique. It combines the single incision technique and the double-bladed scalpel to harvest grafts at a depth compatible with a bilaminar nature. The superficial side includes part of the densest area of the lamina propria, while the deeper side includes a higher content of connective and vascular tissue.[40]

Factors influencing the choice of technique for obtaining soft tissue grafts include the donor site's anatomical characteristics, the graft's quality and histology obtained, the simplicity of the method, postoperative complications, the operator's experience, patient preferences or inherent factors, and clinical outcomes.[34]

The anatomy of the palatal vault can be classified as flat, medium, or high. Therefore, defining a safety zone for extracting connective tissue grafts is essential.[35,41] Tavelli et al. used computed tomography to identify the position of the posterior palatine foramen (PPF) and the position of the palatine artery (PA), which were on average 7, 12, and 17 mm from the cementoenamel junction of the maxillary teeth when the vault was shallow, medium, and high, respectively.[42]

The location of the PPH was estimated to be on the medial and palatal side of the third molar in 57,1 % of cases and between the second and third molars in 21,3 %. In addition, the average distance between the APP and the inter-incisive foramen was 35,8 mm. In comparison, the distance between the APP and the posterior edge of the hard palate was 3,8 mm, and the median suture was 15,2 mm, respectively, with no significant differences between males and females.

The PA's diameter was greater in the molar area and gradually decreased towards the anterior region, except in the second premolar, where it tended to increase. Based on the above, the proposed safety zone indicates the distance from the cementoenamel junction to the PA, including 2 mm of free gingiva in patients with intact, healthy periodontium. However, these references may not be valid in patients with loss of attachment or edentulous areas, in which case other reference points are necessary.[42]

The palatal mucosa comprises three histological layers: the epithelium, the subepithelial connective tissue with the lamina propria, and the submucosa. Age, sex, and population characteristics have been reported as factors that can affect the thickness of the palatal mucosa. The thickness of the masticatory mucosa has been evaluated in different studies, determining that the thickness in the tuberosity area was more significant than 4 mm and in the palatal region was, on average, three mm.[35,43]

The ortho-keratinized epithelium zone was similar in both regions; the subepithelial connective tissue area and the basal lamina zone were well vascularized with small vessels distributed among the collagen fibers and, deeper down, the submucosal tissue with adipose and glandular cells. However, tuberosity grafts have a higher percentage of lamina propria and less submucosa, which is the most significant difference.[42,44] In summary, grafts from different donor sites appear to have characteristics that may require selective clinical application based on clinical evidence and depending on the amount of tissue available at the donor sites.[35]

Common postoperative complications include pain and bleeding at the donor site. Zuchelli et al., in their study of patient morbidity after connective tissue graft harvesting and free grafting, concluded that surgical time was significantly shorter for the test group, which correlated significantly with analgesic consumption, and that consumption increased with longer surgical times. Similarly, both groups reported limited postoperative morbidity.[39]

Coronally Advanced Flap (CAF)

The coronally advanced flap is a technique that has evolved, originating in 1985 by Langer and Lange.[27] In 1989, Allen and Miller modified two releasing incisions that start from an apical area at the vertex of the anatomical papilla to lift a partial-thickness flap along its entire length, which is indicated for treating shallow recessions.[32] In 1992, Pini and Prato updated the technique to include horizontal and vertical releasing incisions combined with a Gore-Tex membrane to create partial thickness in the papillae area.[24]

Finally, in 2000, Zucchelli and De Sanctis combined the techniques described above, creating a partial-total-partial thickness flap with de-epithelialization of the anatomical papillae and reconfiguration of the surgical papillae to allow for their correct approximation at the time of coronal flap replacement.[45] The technique described is the most suitable for patients with high aesthetic expectations as it provides the best aesthetic results and is one of the most studied and predictable flaps for treating single-tooth recessions. It is indicated when the height of the apical keratinized tissue at root exposure is > 2 mm. However, some anatomical factors limit its applicability and clinical efficacy. These include the absence or minimal amount (≤1 mm) of keratinized tissue apical to the recession defect, the presence of interdental clinical attachment loss, the presence of a gingival cleft extending toward the alveolar mucosa, the presence of a high frenulum at the soft tissue margin, profound loss of root structure, a root positioned toward the vestibular side, and decreased vestibular depth.[9]

According to the literature, it offers 70-80 % root coverage. The step-by-step procedure is as follows:

- Measure the recession from the gingival margin to the LAC.
- Make two horizontal incisions, each a minimum length of 3 mm, at an apical distance from the papilla vertex equivalent to the recession +1 mm. This will give us our surgical papillae.
- Make two slightly divergent release incisions, beveled not to generate scarring and partial thickness along their entire length.
- Once our surgical papillae have been raised to partial thickness, we use the peri osteotome to create the total thickness, taking advantage of the entire thickness of the flap. We then extend apically with this total thickness to the equivalent of the recession + 1 mm.

- Preparation of the deep partial thickness, with the scalpel parallel to the bone plane, we leave a thin layer of periosteum and first detach the mucogingival line and then the submucosa with the entire periosteal flap.
- Access to the superficial partial thickness to achieve muscle dissection by changing the direction of the scalpel parallel to the flap.
- Once the tension-free flap has been achieved, we smooth the root and de-epithelialize the anatomical papillae that will serve as the vascular bed for anchoring the surgical papillae by suturing.

The coronal replacement flap for multiple recessions allows perfect adaptation of the surgical papilla to the anatomy, eliminating vertical release incisions and allowing the procedure to be performed in a single surgical act. The design can take two forms depending on whether it is the anterior or posterior sector. In the first case, the inter-incisive papilla is the center of rotation, maintaining its insertion. In contrast, in the second case, the center of rotation is located at the level of the canine or the highest recession to be covered.[46,47]

Step-by-step planning:

- Measure the recession of the tooth that will be the center of rotation from the LAC to the gingival margin.
- Add 1 mm to the height obtained and transfer the measurement as a line from the tip of the papilla parallel to the gingival margin.
- Measure the adjacent distal recession and transfer the measurement distally.
- Measure the adjacent mesial recession and transfer the measurement mesially.
- These measurements indicate the distance of the oblique para marginal incisions converging toward the center of rotation, in this example, the canine.
- If the distal tooth has no recession, the incision would be horizontal, not achieving proper adaptation and design. To avoid this, a false recession is planned by making the incision vertical and separating the area of the intervention.
- Lift the partial or total flap.
- De-epithelialize the papillae.
- Reposition the flap up to 1 mm coronal to the LAC.

Pedicled flaps

The first approach to creating a laterally displaced flap dates back to 1950, when Grupe and Warren proposed the technique, achieving root coverage predictability between 65 % and 75 %. However, within its limitations, it was inadequate in cases with a shallow vestibule or insufficient gingival dimensions lateral to the recession site.[47]

In 1987, Nelson described a full-thickness double papilla flap to cover the connective tissue graft. This method was modified in 1992 by Harris using a split-thickness double papilla flap. In a later publication, the same author reported using the technique in 100 consecutively treated defects with an average root coverage of 97,1 %.[48,49]

Blanes describes in his article the bilateral pedicled flap with tunnel as a technique that provides vascular supply to compensate for the lack of blood supply in deep or wide adjacent recessions. In the first stage, the recipient site is prepared by performing a partial-thickness flap while preserving the medial papilla on both recessions. Horizontal incisions are made at the level of the cemento-enamel junction. Vertical incisions at the end of the horizontal incisions are extended approximately 10 to 12 mm apically. The partial-thickness lateral pedicle flaps are reflected without altering the interproximal papilla in the midline. The graft is positioned and sutured in the second stage with simple sutures apically and corally. Suspension sutures may also be used to secure the graft coronally. Finally, the lateral pedicle flaps are rotated mesially and sutured over the facial surface of the roots with suspension sutures. The mesial edges of the lateral pedicle flaps may be sutured to the interproximal papilla with simple sutures.[48]

On the other hand, Espinel describes the laterally positioned pedicle technique in which the flap is raised from the donor site as partial thickness, then divided into full thickness near the recession, and finally moved laterally.[49]

The surgical technique is as follows: First, the tissue collar around the recession is removed by two vertical incisions that meet at an apical point at the base of the recession. The incision corresponding to the side from which the lateral flap will be moved is beveled internally. A wide, externally beveled incision removes the opposite tissue collar. This arrangement allows the lateral flap to overlap a wide bed of fresh connective tissue once it is sutured into position. Another vertical incision is made away from the recession, including the papilla, and extended beyond the alveolar mucosa using an oblique release incision to provide adequate flap mobility.

The flap was separated as follows: First, the half of the flap away from the recession was reflected as partial thickness, then the half of the flap close to the recession was made full thickness. The entire flap was finally released by incision through the periosteum at its apical base. Free of tension, the flap is passively placed over the prepared root surface.

The internally beveled edge of the flap is superimposed over the externally beveled edge of the recipient site, and the margins are sutured with a simple suture. An additional suture is placed to stabilize the flap in the donor area, which is left protected by the periosteum. The sutures are removed after one week.[48]

Zucchelli 2004 describes a modified surgical approach to the original laterally displaced flap procedure for the treatment of single recessions, combining the aesthetic and root coverage advantages of the advanced crown flap with the increased gingival thickness and keratinized tissue associated with the laterally displaced flap technique.[26]

The procedure is described in two stages: preparation of the recipient area and flap design. The recipient area is initially prepared by deep triangular de-epithelialization delimited by three incisions. A first horizontal incision 3 mm long is made in the mesial-distal

direction at the level of the CL, a second vertical beveled incision parallel to the mesial gingival margin of the recession extending to the alveolar mucosa, and a third infraclavicular beveled incision along the distal gingival margin of the recession defect extending into the alveolar mucosa until it crosses the second incision.

The flap design to be mobilized consists of three incisions. The first is infraclavicular, beveled, and equal to the last incision in the recipient area. The second incision is made horizontally submarginal, extending in the mesiodistal direction 6 mm more than the width of the recession defect measured at the LAC. At this point, the author makes an observation that varies depending on the need to preserve at least 1 mm of keratinized tissue from the donor tooth along the mesiodistal extension of the flap. If the probing depth is less than 1 mm, a donor tissue height of 3 mm should be planned, while in the presence of 2 mm of donor tissue, a minimum height of 4 mm of keratinized tissue is required. Finally, the third oblique vertical incision is made, extending toward the mucosa parallel to the first crevicular incision. When the flap is mobilized in the mesial direction, another short horizontal incision is made in its most apical extension to facilitate the mesial movement of the flap.[26]

To allow coronal advancement of the flap, all muscle insertions were removed. The remaining epithelial tissue of the anatomical interdental papillae was de-epithelialized to create connective tissue beds to which the surgical papillae of the coronally displaced flaps were sutured.[26,47]

The synthesis begins by making two simple periosteal sutures at the most apical extension of the vertical release incisions, then advances coronally, along the vertical mesial incision, with other simple sutures, each directed from the flap to the adjacent vestibular soft tissue in an apical-coronal direction. More apically, a double horizontal mattress suture is performed to reduce tension on the lips in the marginal portion of the flap. After these sutures, the most marginal portion of the flap was held stable in the coronal position with a suspension suture. The coronally positioned flap has been suggested as the treatment of choice for localized gingival recessions without altering adjacent teeth.[47] The reason for the lack of interest in pedicle techniques is related to the fact that the data do not seem to indicate that this technique achieves highly predictable and effective root coverage, with the coronal repositioning flap being the treatment of choice for localized gingival recessions without altering the margins of adjacent teeth.[26,47,48]

Tunnel techniques

In 1999, Zabalegui et al. connected multiple mesial and distal envelopes without detaching the papilla, forming a mucosal tunnel and creating the tunnel technique. It is based on constructing a tunnel under the gingival tissue consisting of a sulcular incision beyond the mucogingival line without lifting the papilla. A large connective tissue graft from the palate is inserted through the tunnel to cover the adjacent gingival recessions. This technique allows the treatment of multiple adjacent gingival recessions in a single procedure with adequate early healing and highly predictable coverage results.[50]

The procedure begins by making partial-thickness intracellular incisions, preserving the papilla, and undermining the coronal tissue to the cementoenamel junction until it passes the mucogingival line. The dissection extends laterally through the papilla between the teeth, which remains intact. A connective tissue graft is then harvested and placed in the recipient bed using vertical mattress sutures.[51]

In 2007, Zuhr et al. reevaluated the tunnel technique, as it was considered a difficult approach that was sensitive to the operator's skill, requiring a uniform thickness above the periosteum for the graft to slide correctly into the recipient site. Advances in microsurgery have introduced the use of new instruments to minimize trauma and ensure better blood supply to the graft.[50]

The technique described by the author begins by making intracellular incisions around the affected tooth necks using a micro scalpel blade with sharp edges on both sides and at the tip, followed by the collaboration of tunnelers, which have different working angles allowing access to the anterior sector while avoiding the convexity of the vestibular surfaces. The undermining extends to the mucosa, and then each of the accesses is connected to partial thickness, allowing the placement of a connective tissue graft. Once the connective tissue graft is in place, vertical mattress sutures are used to perform a mattress suture starting from the palatal area, allowing coronal mobilization of the tissues. The suture should take the vestibular flap and the subepithelial connective tissue to stabilize the CTG.

In 2010, Aroca published the modified coronal advancement tunnel technique for treating multiple Miller class III recessions, performing composite stitches in the interproximal areas that allow the tissue to be held in place during healing using horizontal mattress sutures with a loop.[52] The surgical approach begins with an acid etching technique, adhesive, and composite stitches at the contact points. An intracellular incision of full thickness is then made above the recessions, advancing with tunnelers until the mucogingival line is passed. Once a uniform bed has been achieved that allows tension-free displacement, the graft is inserted through the broadest area of the recession using a mattress suture, and the flap is finally displaced with horizontal mattress sutures with loops.[52]

Laterally positioned flap with stretching (LAST)

In 2019, Carranza presented an alternative treatment to the traditional lateral flap procedure and tunneling techniques commonly used to cover deep and narrow recessions: the "lateral flap with stretching" using connective tissue grafting. The aim of treating this type of recession with displaced flaps is to improve nutritional supply in the absence of vertical incisions while producing a more stable wound with minimal scarring and less discomfort for the patient.[53]

The surgical technique is described below step by step: It begins by making infraclavicular incisions involving the tooth with the recession and at least one adjacent tooth on each side. A partial-thickness flap is prepared with tunnelers, extending the bed to 1 or 2 adjacent teeth. In areas with a thin phenotype, a full-thickness flap is made. On the other hand, the technique presented can be modified by two horizontal incisions described by Bruno, allowing the graft to be placed in a more coronal position and improving

access and visibility. A connective tissue graft is then taken using a double scalpel blade technique, extending 5 mm on each side and 5 mm apical to the deepest recession. The graft is placed in the recipient bed and held in place with mattress sutures on both sides of the flap. Then, the lateral edges of the recession are approximated with simple sutures without taking the underlying graft to cover it, minimize exposure, and stabilize the wound.

Subperiosteal Tunnel Access Technique via Vestibular Incision (VISTA)

Zadeht introduces a novel and minimally invasive approach applicable to both isolated recession defects and multiple defects in the anterior region of the maxilla, obtaining access to the surgical site through an approach called subperiosteal tunnel access via vestibular incision, reducing associated morbidity and minimizing scar formation at the recipient site.[54]

As we have been reviewing in the overview of current techniques, tunnel preparation uses an intracellular approach to create a subperiosteal space that extends beyond the mucogingival junction, allowing the graft tissue to be inserted under the gingival collar. Limitations of this tunnel access technique include the technically challenging bone anatomy due to the small marginal access point and the increased risk of traumatizing and perforating sulcular tissues, potentially leading to unfavorable healing outcomes. As a result of these limitations, the vestibular incision subperiosteal tunnel access (VISTA) approach was developed to avoid some potential complications of intracellular tunneling techniques. The technique involves making an access incision in the anterior superior frenulum, followed by the elevation of a subperiosteal tunnel. However, the location of the access incision depends on the sites to be treated. This tunnel extends at least one or two teeth beyond the root recession to mobilize the gingival margins and facilitate coronal repositioning. Furthermore, it is essential to extend the elevation sufficiently beyond the mucogingival margin and through the gingival sulci of the teeth to be augmented to allow for low-tension coronal repositioning of the gingiva. In addition, the subperiosteal tunnel is extended in the interproximal area below each papilla as far as the pocket space allows without making superficial incisions through the papillae. Once the bed has been prepared, a connective tissue graft or collagen membrane is placed, and suturing is performed using a new method of gingival margin stabilization called coronally anchored suturing, designed to maintain the coronal position of the gingival margins during healing.[54]

Flowchart for decision-making in single and multiple recessions in the anterior region

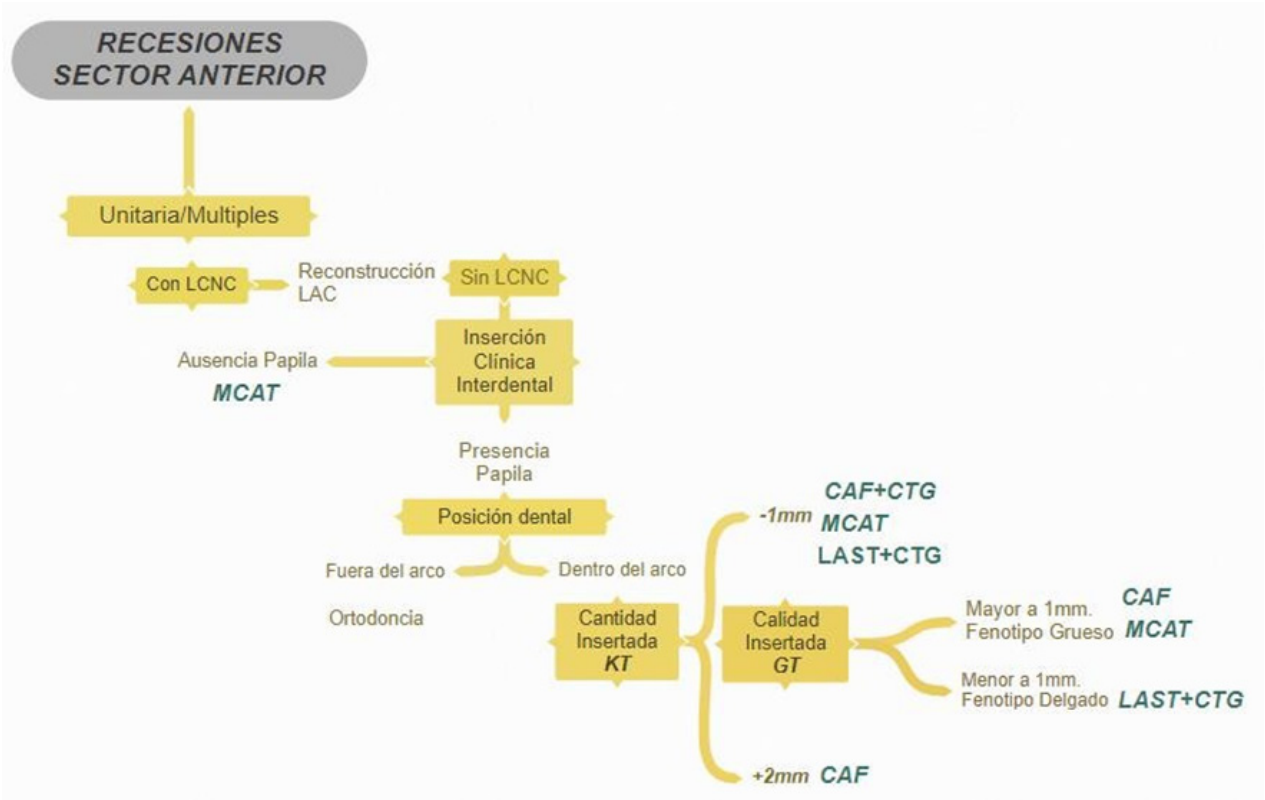

Figure 1. Flowchart for decision-making in the treatment of anterior recession.

Note: LCNC, non-carious cervical lesion. LAC, amelocemental limit. KT, keratinized tissue. GT, gingival thickness. MCAT, modified coronal advancement tunnel. CAF, coronal advancement flap. CTG, connective tissue graft. LAST, Lateral advancement technique with stretching

To determine the appropriate technique for each clinical case, we must first consider eliminating any inflammatory condition by performing basic therapy, leaving a surface compatible with health without pocket depth or bleeding.[16]

From a topographical point of view, the presence of non-carious cervical lesions should be considered through combined restorative/periodontal treatment, facilitating the reconstruction of the cementoenamel junction and providing a smooth, stable, and convex surface for the surgical flap.[55]

The literature describes the relationship between gingival recession and orthodontic treatment. For this reason, it is essential to manage the patient concomitantly between the periodontist and the orthodontist, primarily if the pathology exists before starting corrective treatment. In cases where orthodontic treatment is poorly managed, the periodontal tissues are severely affected, and the prognosis is worsened if the treatments are not adequately monitored.

The amount of gum inserted to maintain the health and stability of the gingival margin may be less than 2 mm, provided that good oral hygiene is maintained. Many studies conclude that using surgical procedures to increase the keratinized gingival band is questionable.[23]

CONCLUSIONS

The results of the theoretical discussion confirm that selecting one surgical technique over another depends mainly on the local anatomical characteristics of the site to be treated and, secondarily, on the patient's aesthetic demands, which become relevant when defining the approach.

Furthermore, clinical aspects and personalizing the treatment plan according to each patient's specific needs are essential to ensure a comprehensive and interdisciplinary approach that collaborates with the periodontist to achieve successful root coverage that improves aesthetics and long-term periodontal health.

According to the literature review, periodontal health can be maintained in most patients even with minimal amounts of keratinized tissue, but gingival recession is common in cases of thin periodontal phenotypes, poor oral hygiene, or orthodontic treatment. Mucogingival surgical interventions are used to prevent or treat recessions, addressing aesthetic concerns, hypersensitivity, and related health parameter alterations.

Miller Class I and II recessions are the most predictable for root coverage, while Classes III and IV require more planning and professional experience. There are various surgical techniques, from free grafts to coronal advancement tunnels, which seek to improve periodontal health and aesthetics, considering the individual needs of each patient and the interdisciplinary collaboration of different dental specialties.

The decision-making flowchart includes the following key points: Single or multiple recession, depth and type of recession, interdental clinical attachment level, amount of attached gingiva, and gingival tissue quality.

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CONFLICT OF INTEREST

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AUTHORSHIP CONTRIBUTION

Conceptualization: Ianina Solange Silvera.
Data curation: Ianina Solange Silvera.
Formal analysis: Ianina Solange Silvera.
Research: Ianina Solange Silvera.
Methodology: Ianina Solange Silvera.
Project management: Ianina Solange Silvera.
Resources: Ianina Solange Silvera.
Software: Ianina Solange Silvera.
Supervision: Ianina Solange Silvera.
Validation: Ianina Solange Silvera.
Visualization: Ianina Solange Silvera.
Writing – original draft: Ianina Solange Silvera.
Writing – review and editing: Ianina Solange Silvera.

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